

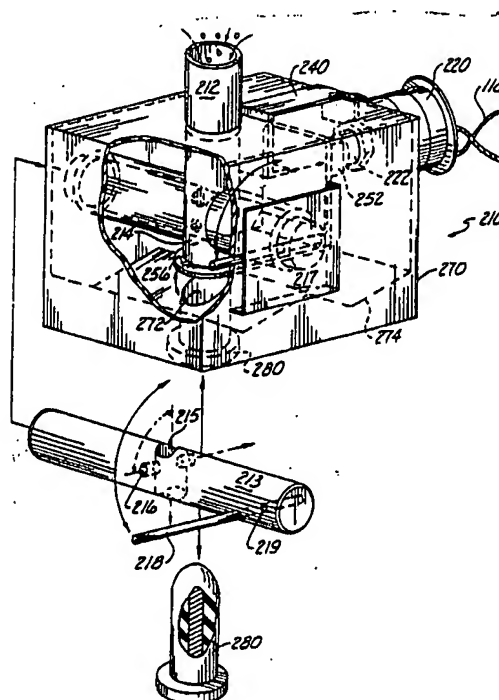


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>5</sup> :</b>  <b>A01C 7/10, 7/18</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 94/08446</b>  <b>(43) International Publication Date:</b> 28 April 1994 (28.04.94)
<b>(21) International Application Number:</b> PCT/US93/09521 <b>(22) International Filing Date:</b> 4 October 1993 (04.10.93)  <b>(30) Priority data:</b> 07/961,460 15 October 1992 (15.10.92) US  <b>(71) Applicant:</b> ZENECA INC. [US/US]; 1200 South 47th Street, Box 4023, Richmond, CA 94804-0023 (US). <b>(71)(72) Applicant and Inventor:</b> CONRAD, Larry, M. [US/US]; Rural Route 1, Box 103, Delta, IA 52550 (US). <b>(72) Inventor:</b> WALTON, David, S. ; 483 West Street Road, Kennett Square, PA 19348 (US).		<b>(74) Agents:</b> ACKERMAN, Joel, G. et al.; Zeneca Inc., 1200 South 47th Street, Box 4023, Richmond, CA 94804-0023 (US).  <b>(81) Designated States:</b> AU, CA, JP, UA, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).  <b>Published</b> <i>With international search report.          Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>

**(54) Title:** ELECTROMAGNETIC METER FOR CLOSED DISPENSING CONTAINER**(57) Abstract**

A metering device (10) for controlling the flow of granular material through a conduit (12). The metering device (10) includes an electrical coil (20) operably associated with the conduit (12), a ferromagnetic latching strip (40) disposed in the magnetic field produced by the coil (20), and a pivoting gate (50) including a magnet (52) that is attracted toward and repelled from the latching strip (40) as the direction of electrical current flowing through the coil (20) is changed. A closed container (100) includes the metering device (10) secured to its bottom so that the granular material can be dispensed only through the meter. The closed container (100) is electrically connected by wires to a dispensing controller (300) located in the tractor cab. The granular material, such as insecticide, is simultaneously and equally dispensed at the desired rate to the seed furrows from all the individual planting units of the planter.



**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	FR	France	MR	Mauritania
AU	Australia	GA	Gabon	MW	Malawi
BB	Barbados	GB	United Kingdom	NE	Niger
BE	Belgium	GN	Guinea	NL	Netherlands
BF	Burkina Faso	GR	Greece	NO	Norway
BG	Bulgaria	HU	Hungary	NZ	New Zealand
BJ	Benin	IE	Ireland	PL	Poland
BR	Brazil	IT	Italy	PT	Portugal
BY	Belarus	JP	Japan	RO	Romania
CA	Canada	KP	Democratic People's Republic of Korea	RU	Russian Federation
CF	Central African Republic	KR	Republic of Korea	SD	Sudan
CG	Congo	KZ	Kazakhstan	SE	Sweden
CH	Switzerland	LJ	Liechtenstein	SI	Slovenia
CI	Côte d'Ivoire	LK	Sri Lanka	SK	Slovak Republic
CM	Cameroon	LU	Luxembourg	SN	Senegal
CN	China	LV	Latvia	TD	Chad
CS	Czechoslovakia	MC	Monaco	TG	Togo
CZ	Czech Republic	MG	Madagascar	UA	Ukraine
DE	Germany	ML	Mali	US	United States of America
DK	Denmark	MN	Mongolia	UZ	Uzbekistan
ES	Spain			VN	Viet Nam
FI	Finland				

# ELECTROMAGNETIC METER FOR CLOSED DISPENSING CONTAINER

## Cross Reference to Related Applications (Claiming Benefit Under 35 U.S.C. 120)

5 This application is a continuation-in-part of  
Application Serial No. 07/779,075, filed October 18,  
1991, by Larry M. Conrad, now U.S. Patent No.  
5,156,372, issued October 20, 1992.

## Incorporation by Reference

10 The above referred to related application is  
incorporated herein by reference in its entirety, and  
hereby is made a part of this application.

## "Electromagnetic Meter for Closed Dispensing Container"

### Technical Field

15 This invention relates to metering devices, and  
more particularly to electromagnetic metering devices  
used in a closed dispensing container for granular  
materials.

Background Art

Various electromagnetic metering devices are known but none are completely satisfactory for handling granular materials. Devices opened and closed by a sliding action, such as a solenoid valve, are often jammed by the granular material and are slow to open and close.

Co-pending U.S. Patent Application Serial No. 07/779,075, now issued as U.S. Patent No. 5,156,372 to one of the co-inventors herein, discloses electromagnetic metering devices which overcome these problems. The availability of reliable metering devices has led applicants to consider the solution of various dispensing problems using these electromagnetic metering devices.

Agricultural workers are frequently required to handle hazardous materials such as pesticides, herbicides, fungicides, fertilizers, and even treated seeds that present a hazard to the worker, co-workers, children, farm animals and the environment in general. Many hazardous materials are packaged in standard fifty-pound paper or plastic bags. Unused materials in unopened bags, opened bags, and in chemical hoppers increases the risk of accidental exposure at times when the unwary worker is not focused on the need to take precautions.

One setting where the worker is required to handle large quantities of hazardous materials is during the planting operation. In the planting operation, almost all soil insecticides are applied from a storage hopper carried on the subframe of a planting unit. Typically, an hour-glass type device is used to control the flow of insecticide from the storage hopper to the seed furrow. Rate selections are made by adjusting the diameter or flow area of the constriction zone. A meter wheel feeds the reservoir above the constriction zone in excess of flow needs and stops the flow when

the planting unit is raised or the drive chain removed. Once the initial settings are made, flow rate from these devices is a function of time only. Therefore, the worker must determine the planting speed and stick to it to achieve planting rate accuracy. Further, there is great variation from one storage hopper to another and each row must be individually calibrated and rechecked periodically. Also, as the desired application rates are lowered, the accuracy of the hour-glass device becomes very erratic and eventually non-functional.

Those concerned with these and other problems recognize the need for an improved metering device for granular materials.

Disclosure of the Invention

5 The present invention provides a metering device  
for controlling the flow of granular material through a  
conduit. The metering device includes a electrical  
coil operably associated with the conduit, a  
ferromagnetic latching strip disposed in the magnetic  
field produced by the coil, and a pivoting gate  
including a magnet that is attracted toward and  
repelled from the latching strip as the direction of  
10 electrical current flowing through the coil is changed.

A closed container includes the metering device  
secured to its bottom so that the granular material can  
be dispensed only through the meter. The closed  
container is electrically connected by wires to a  
15 dispensing controller located in the tractor cab. The  
granular material, such as insecticide, is  
simultaneously and equally dispensed at the desired  
rate to the seed furrows from all the individual  
planting units of the planter.

20 An object of the present invention is the  
provision of an improved metering device for hazardous  
and other granular materials or seeds.

Brief Description of the Drawings

These and other attributes of the invention will become more clear upon a thorough study of the following description of the best mode for carrying out the invention, particularly when reviewed in conjunction with the drawings, wherein:

Fig. 1 is a partial perspective view of one embodiment of the invention;

Fig. 2 is an enlarged sectional view taken along line 2-2 of Fig. 1;

Fig. 3 is a partial perspective view of a second embodiment of the invention;

Fig. 4 is an enlarged sectional view taken along line 4-4 of Fig. 3;

Fig. 5 is a sectional view taken along line 5-5 of Fig. 4;

Fig. 6 is an enlarged sectional view of a third embodiment of the invention similar to the second embodiment but showing the gate pivot point raised to accommodate a different mounting structure;

Fig. 7 is a partial perspective view of a fourth embodiment of the invention;

Fig. 8 is an enlarged sectional view taken along line 8-8 of Fig. 7;

Fig. 9 is a partial perspective view of a fifth embodiment of the invention;

Fig. 10 is a sectional view taken along line 10-10 of Fig. 9;

Fig. 11 is a perspective view of a single planting unit utilizing the closed granular dispensing container of the present invention;

Fig. 12 is a partial exploded perspective view showing portions of the planting unit subframe and the relative positions of both the insecticide and herbicide funnels which direct granular material to the appropriate location during the planting process;

Fig. 13 is a partial side elevational view showing

the dispensing container mounted on the planting unit subframe with portions cutaway to show the relative positions of the dispensing valve and the insecticide funnel;

5           Fig. 14 is a top plan view of the closed container with a portion cutaway to show the position of the electromagnetic metering valve;

          Fig. 15 is a sectional view taken along line 15-15 of Fig. 14 showing one embodiment of a metering valve  
10           used with the closed container;

          Fig. 16 is a sectional view taken along line 16-16 of Fig. 15, showing the tamper resistant mounting flange which attaches the metering valve to the closed container;

15           Fig. 17 is a sectional view taken along line 17-17 of Fig. 16 showing the internal components of the metering valve;

          Fig. 18 is an exploded perspective view of the metering valve showing the manually set flow adjusting  
20           spool which establishes the maximum flow rate from the closed container through the conduit at the metering valve and showing the friction-fit transport plug;

          Fig. 19 is a sectional view similar to Fig. 17 showing the internal components of the metering valve;

25           Fig. 20 is a sectional view showing the internal components of an alternate embodiment of a metering valve suitable for use with a closed container;

          Fig. 21 is a front elevational view of a control panel accessible to the user in the tractor cab to  
30           control the flow of granular material from the closed container, through the metering valve, to the seed furrow formed by the planting unit;

          Fig. 22 is a front elevational view of an alternate embodiment of a user control panel; and

35           Fig. 23 is a block diagram illustrating the inputs to the meter control.



Best Mode for Carrying Out the InventionDescription of Figs. 1-10.

Referring now to the drawings, wherein like reference numerals designate identical or corresponding parts throughout the several views, Figs. 1 and 2 show one embodiment of the metering device (10) of the present invention suitable for mounting in the granular insecticide conduit (12) of a conventional agricultural planter. The metering device (10) includes an electrical coil (20) disposed to surround the conduit (12), a switch (30) for changing the direction of current flowing through the coil, an iron latching strip (40) disposed within the magnetic field produced by the coil (20), and a gate (50) formed of a round magnet (52) pivotally attached to the conduit by a hinge (54). The gate (50) is pivotally movable to the full-line position of Fig. 2 to cover the discharge opening (14) in the conduit (12) when the magnet (52) is attracted to and contacts the latching strip (40).

Granular material flows down the conduit (12) and out the discharge opening (14) when the gate (50) is open. The position of the flow gate (50) is controlled by the direction of the current flow in coil (20). When the magnetic field of the coil (20) is in the right direction, the flow gate (50) is forced up against the discharge opening (14), cutting off the granular flow. The iron latch strip (40) holds the flow gate (50) closed even when the power is turned off. The iron latch strip (40) is also necessary because the gate (50) will not completely close without it, or open or close with a quick response. When the magnetic field from the coil (20) is reversed, the iron latch strip (40) changes its magnetic polarity and repels the magnet (52). The magnetic field also repels the magnetic flow gate (50) so it is forced into the open position. The gate (50) will remain in the position it was in when the current is turned off,

unless it is given a hard jolt.

Figs. 3-5 show a second embodiment of the metering device (10) that is adapted to bolt to the bottom of an International Harvester 400 planter insecticide hopper (not shown). A plate (16) bolts to the bottom of the hopper. The flow gate (50) is redesigned because the magnet (52) needs to remain inside of the coil (20). The angled bracket (56) which forms a part of the flow gate is made of aluminum.

The operation of the second embodiment is basically the same as that of the first embodiment. Granules flow through the discharge opening (14) and the flow gate (50) pivots to open and close the discharge opening (14). In this embodiment the flow gate (50) automatically closes by gravity, anytime the flow of current doesn't hold it open. Therefore, electrical power is only needed to open it but it will not close as strongly as if it were closed with power.

Fig. 6 shows a third embodiment of the metering device (10) suitable for use with an International Harvester 800-900 planter. The only difference between it and the second embodiment is that the flow gate magnet (52) is mounted farther from the hinge (54), allowing the discharge opening (14) to be raised above plate (16). This embodiment will bolt in the hole on the planter that holds the funnel that the insecticide hose attaches to, therefore, no modifications are needed to mount it to the planter.

Fig. 7 and 8 show a fourth embodiment of the invention where the coil (20) is disposed outside of the conduit (12). A metallic frame or magnetic flux guide (60), extends around the coil (20). The flux guide (60) routes the magnetic flux lines to provide the proper magnetic field to control the gate magnet (52).

Figs. 9 and 10 show a fifth embodiment of the invention similar to the fourth embodiment but

incorporating a chamber (70) having a material outlet (72). This design reduces the possibility of chemical waste due to unit malfunction. The other embodiments can be left in a condition where the granular material will flow through the conduit (12) without obstruction when the gate (50) is in the open position. This embodiment works in a toggle fashion where the current must be turned on and then reversed to allow chemical to pass through the unit. Thus each time it toggles a specific amount of chemical is released from the chamber (70).

Description of Figs. 11-23.

Fig. 11 shows an individual planting unit (80) attached by a four-bar linkage (82) to a tool bar (84). Typically, a number of planting units (80) are attached to the tool bar (84) in side-by-side relationship and pulled through a prepared field by a tractor to plant row crops such as corn or soybeans. Each of the planting units (80) includes a subframe (86) which supports a seed hopper (88) on the forward portion and a conventional granular chemical hopper (not shown) on the rearward portion. In Figs. 11-13, the closed dispensing container (100) of the present invention is shown mounted on the rearward portion of the subframe (86) in the position normally occupied by the conventional chemical hopper. The rearward portion of the subframe also supports an insecticide funnel (90) and/or a herbicide funnel (92) each of which direct granular material through lines (94 and 96) to the appropriate location during the planting process. Also, locator pins (98) extend up from opposite sides of the subframe.

The closed dispensing container (100) includes sidewalls (102), a top wall (104), a sloping bottom wall (106), and a bottom skirt section (108) that extends down from the sidewalls (102). A pair of recessed hand grips (110) are formed in the front and

rear sidewalls (102) and a pair of support brackets (112) are attached to the lateral sidewalls (102). It is to be understood that a universal adapter may be used so that the container (100) may be supported and secured on planting units made by all manufacturers, thus eliminating the need to attach brackets (112) to the sidewalls (102). The support brackets (112) rest on the subframe (86) and the locator pins (98) extend through openings in the brackets (112) and are secured by spring clips (99). As shown in Fig. 14, access to and from the closed container (100) is available only through the single opening (101) in the bottom wall (106).

As best shown in Figs. 14-17, an electronic meter (210) is attached to the bottom wall (106) of the closed container (100) by a mounting flange (114) attached with tamper-resistant fasteners (116). Power to the meter (210) is supplied through wires (118) that lead to a connector (120) affixed to the front wall of the skirt section (108). A removable plug-in connector (122) is disengaged from the connector (120) when the container (100) is removed from the subframe (86).

Referring now to Figs. 17-19, an embodiment of the meter (210) is shown and includes a conduit (212) in flow communication with the opening (101) in the bottom wall (106) of the closed container (100). A rotatable flow control spool (213) intersects the conduit (212) above the discharge opening (214). Apertures (215 and 216) of different diameters extend through the spool (213) and are aligned with the conduit (212). One end of the spool (213) extends through a tab (217) and a lever (218) is inserted in an opening (219) in the spool (213) to secure the spool (213) in alignment. Movement of the lever (218), as shown by the directional arrows (Fig. 18) changes the aperture (215 or 216) which aligns with the conduit (212) to limit the flow of granular material that flows to the

discharge opening (214).

5 The meter (210) includes an electrical coil (220) disposed at one side of the conduit (212), a switch (not shown) for changing the direction of the current flowing through the coil (220), an iron latching strip (240) disposed within the magnetic field produced by the coil (220), and a gate (250) pivotally attached at one side of the conduit (212) by a hinge (254). A magnet (252) and a L-shaped bracket (256) make up the pivoted gate (250). A chamber (270) encloses the gate (250), the core (222) of the coil (220), and the discharge opening (214) of the conduit (212). The chamber (270) has a material outlet (272) located in its floor (274) and disposed so that one end of the L-shaped bracket (256) covers the material outlet (272) when the gate (250) engages the latching strip (240). A material overflow outlet (276) is formed at a low point in the floor (274) remote from the material outlet (272). Each cycle of the gate (250) between the closed position, shown in full line in Fig. 19, and the open position, shown in dashed line in Fig. 19, allows a specific amount of granular material to be released from the chamber (270) to feed into one of the funnels (90 or 92) of the planting unit (80). As best shown in Fig. 15, a friction-fit transport plug (280) is received in the material outlet (272) of the chamber (270) and extends up to contact the L-shaped bracket (256) of the gate (250). The plug (280) holds the gate (250) in the closed position when the container is being transported.

Another embodiment of the meter (210) is shown in Fig. 20. This embodiment is similar to that shown in Figs. 15-19 except for the relative positions of the coil (220) and the latching strip (240). This arrangement allows for a linear bracket (258) in place of the L-shaped bracket (256).

Figs. 21 and 22 show alternate embodiments of a

control panel (290) accessible to the user from the cab of a tractor. The face plate (292) of the panel shown in Fig. 22 indicates the information monitored and processed by the control. These same categories of information will be indicated on the display (294) together with the appropriate numerical values.

Fig. 23 illustrates the inputs to the meter control (300). The electronic control (300) measures ground distance and drops a specific amount of granular chemical at the calibrated distance. The system can be calibrated in the shop without operating the planter and can be used to change rates in the tractor cab electronically. The control (300) also monitors flow to indicate plugging or an empty container (100).

The control (300) receives a signal from a magnetic sensor on a rotating shaft driven from a ground wheel or a conventional sonar-type ground speed unit. The processing circuit takes a signal from a distance input, a manual control is used to adjust rates, and manual control is used to calibrate the meter display. The display furnishes the operator with information on total pounds applied, pounds per acre, total acres and ground speed. The processing circuit uses the inputs to display the information to the operator and control the meter flow rate. It also turns the meter off before the planter is raised and turns it on after the planter is lowered to prevent waste.

The present invention significantly improves on the accuracy of insecticide placement and significantly improves handler safety by reducing accidental exposure rates of pesticides.

The present invention has several key safety, environmental, and economic advantages.

The present invention provides a totally closed system. Short of physical damage to the container or willful misuse, there is no way for the farmer to

access the product. The product is dispensed electronically from a moving planter only. Because of the closed system, higher concentrations of pesticide can be used. This reduces the poundage that must be handled and reduces the opportunity for physical damage and consequent exposure.

The totally closed system provides little opportunity for exposure to farm animals and children since the package is relatively impermeable and inaccessible except via a moving planter. This compares favorably against the standard 50 pound paper or plastic bag. In addition, there have been accidental poisonings by exposure to pesticide in the planter hoppers where the lids are not lockable. In the distribution channels, the risks are reduced by impermeable containers. Also, if the product is concentrated, less product to handle, ship and store results in less expense.

The system accurately dispenses pesticide according to the desired rate regardless of ground speed and enables the farmer to adjust desired rates on the go from zero to the full label rate. This enables the minimum desired rate to easily be dispensed. At the end-rows, quicker shut-off and start-up mechanism reaction times enables a more complete incorporation of the pesticide granules and less exposure to birds or run-off.

The farmer is able to save money by varying the lowest desirable rate on the go including shut-off where the pesticide is not needed. The farmer also saves money by minimizing end-row wastage. Further, the electronic metering system indicates if any row is not operating at the desired rate and thus prevents the economic loss of inadequate protection from inadequate rates. The farmer may return the unused pesticide in the returnable closed container for a refund of the unused portion, therefore, saving by using precisely

what they need. Also, the initial capital costs of a planter can be lowered by eliminating the costs of existing hopper and chain drive assemblies.

5 Thus, it can be seen that at least all of the stated objectives have been achieved.

Obviously, many modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that, within the scope of the appended claims, the  
10 invention may be practiced otherwise than as specifically described.



## WE CLAIM:

1. An electronic metering device for fluent material selected from pesticides, insecticides, herbicides, fungicides, fertilizers and/or seeds, comprising:

a closed container including a bottom wall having an opening, the closed container being disposed to carry a supply of said fluent material;

an electronic meter attached to the closed container, the meter including a housing and a conduit disposed within the housing, the conduit having a discharge opening disposed in flow communication with the opening in the container, the meter further including:

an electrical coil operably attached to the conduit and being disposed to produce a magnetic field when electrical current flows through the coil;

switch means for selectively changing the direction of the electrical current flowing through the coil;

a ferromagnetic latching strip operably attached to the conduit and disposed within the magnetic field produced by the coil; and

a gate pivotally attached within the meter housing and being movable between a closed position covering the discharge opening and an open position spaced from the discharge opening, the gate including a magnet which is attracted to and contacts the latching strip when current flows through the coil in a first direction and which is repelled from and is spaced away from the latching strip when current flows through the coil in a second direction; and

means for selectively sequencing the switch means to set a frequency for a cycle of movement of the gate between the closed position and the open position, the cycle frequency being effective to accurately control the amount of fluent material flowing from the meter over a predetermined time period.

2. The metering device of Claim 1 wherein the metering device is attached to an implement disposed to travel over a work surface at a variable speed, the metering device further including:

means for sensing the variable speed of the implement; and

means for varying the cycle frequency set by the sequencing means as the speed of the implement varies, whereby the amount of fluent material flowing from the meter is controlled by the distance of travel of the implement.

3. The metering device of Claims 1 or 2 further including a chamber disposed in flow communication with the discharge opening, the chamber including a material outlet disposed to be covered by the gate when the gate is in the open position spaced from the discharge opening.

4. The metering device of Claim 2 further including a chamber disposed in flow communication with the discharge opening, the chamber including a material outlet disposed to be covered by the gate when the gate is in the open position spaced from the discharge opening.

5. The metering device of Claim 2 wherein the implement is a planting unit having a subframe including a means for directing fluent material to a seed bed, and wherein the closed container includes sidewalls having

attached brackets disposed to be supported on the subframe such that the attached meter is disposed above the directing means in flow communication therewith.

6. The metering device of Claim 3 further including a removable friction-fit transport plug disposed to be received in the material outlet of the chamber and disposed to extend upward to contact the gate and hold the gate in the closed position when the container is being transported.

7. The metering device of any of Claims 1-6 further including a rotatable flow control spool disposed to intersect the conduit above the discharge opening, the flow control spool including a plurality of apertures of varying diameters extending through the spool, the spool being selectively rotatable to align one of the plurality of apertures with the conduit to limit the flow of granular material to the discharge opening.

8. The metering device of any of Claims 1-7 wherein the fluent material is a granular material.

9. A metering device, comprising:

a. self-contained environmentally sealed closed container adapted to be filled with a supply of fluent material, the container including:

a discharge opening; and

meter means sealingly attached to the container in flow communication with the discharge opening for permitting the controlled discharge of material from the container;

means for removably mounting the container on an implement; and

means operably attached to the implement for activating the meter means when the container is mounted on the implement.

10. The metering device of Claim 9 wherein the amount of material flowing from the meter means is controlled based on a predetermined parameter, wherein the implement is disposed to travel over a work surface at a variable speed, and wherein the predetermined parameter is distance traveled by the implement.

11. The metering device of Claims 9 or 10 wherein the meter means includes means for preventing the flow of material from the meter means when the implement is stationary.

12. The metering device of any of Claims 9-11 wherein the meter means is electronically operated.

13. The metering device of any of Claims 9-12 wherein the container is pre-filled with fluent material.

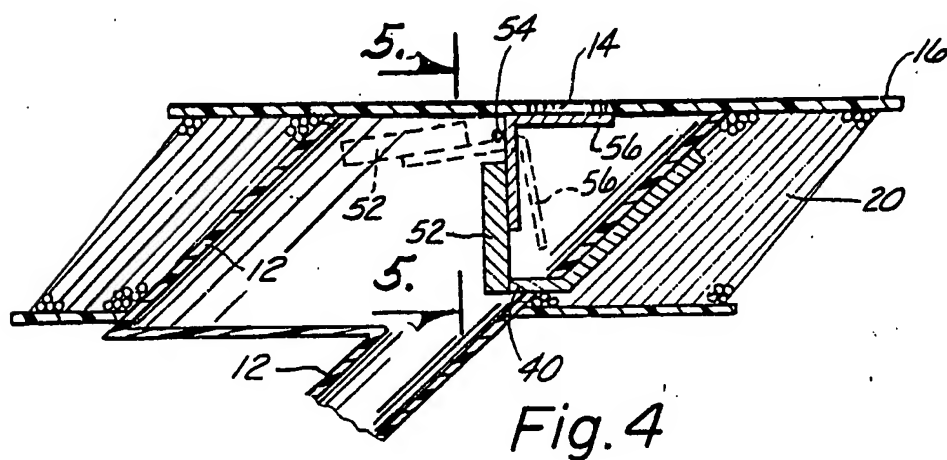
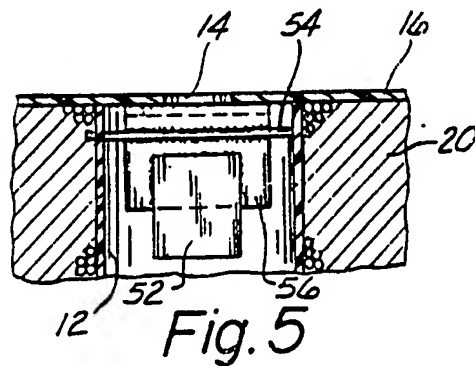
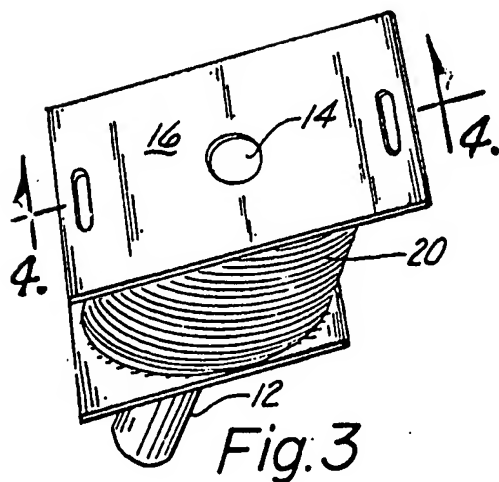
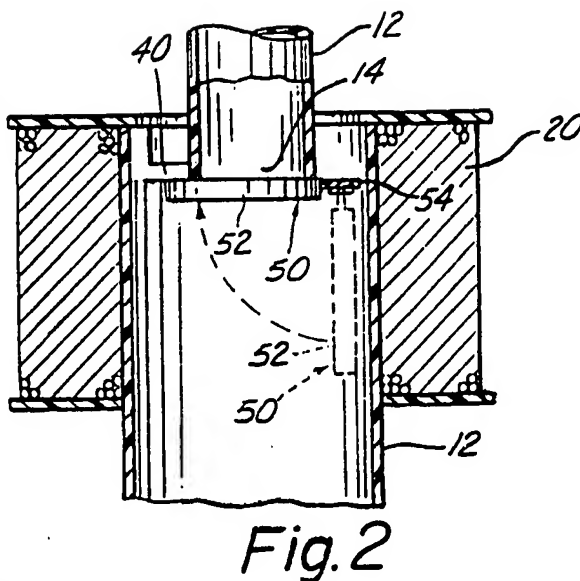
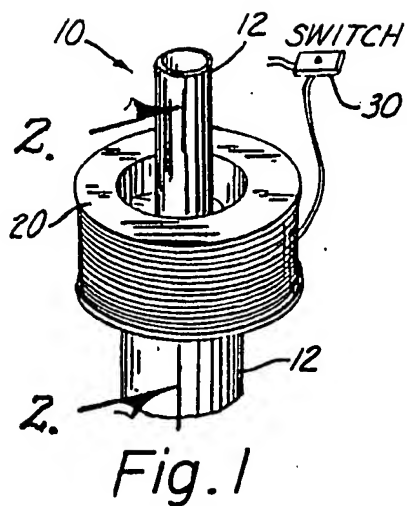
14. The metering device of any of Claims 9-13 wherein the material is to be dispensed while isolated from an operator.

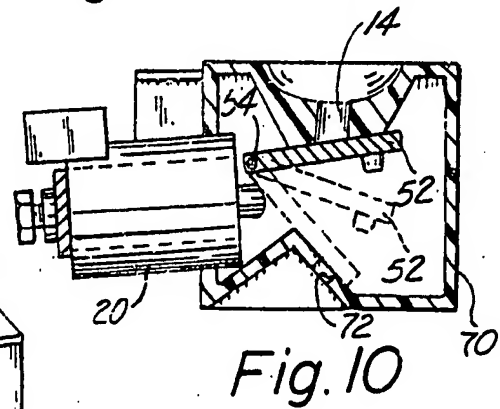
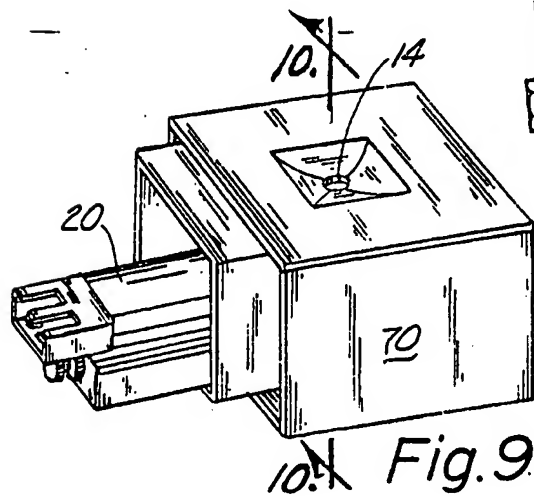
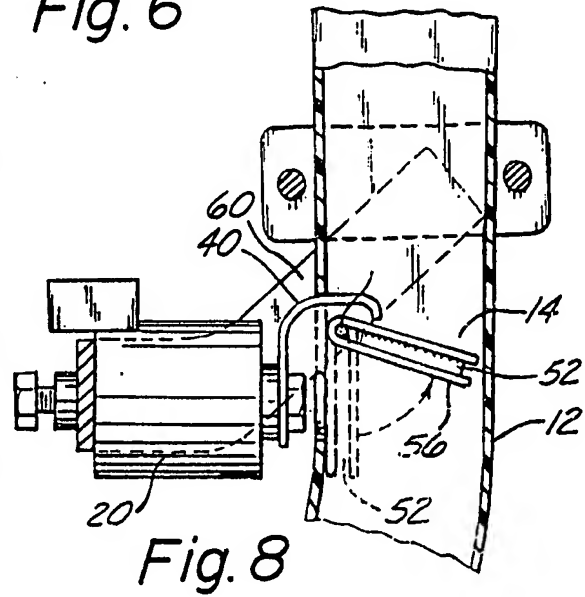
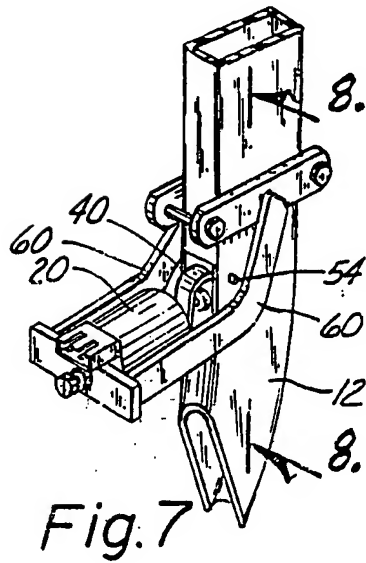
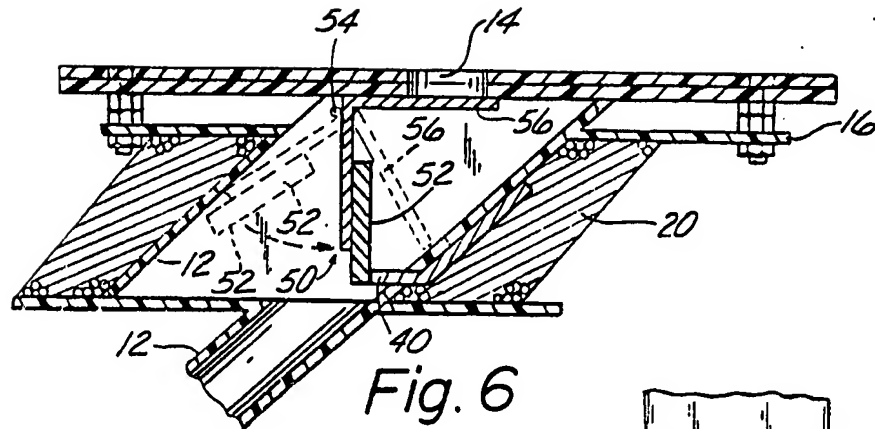
15. The metering device of any of Claims 9-14 wherein the material is fluent material selected from pesticides, insecticides, herbicides, fungicides, fertilizers and/or seeds.

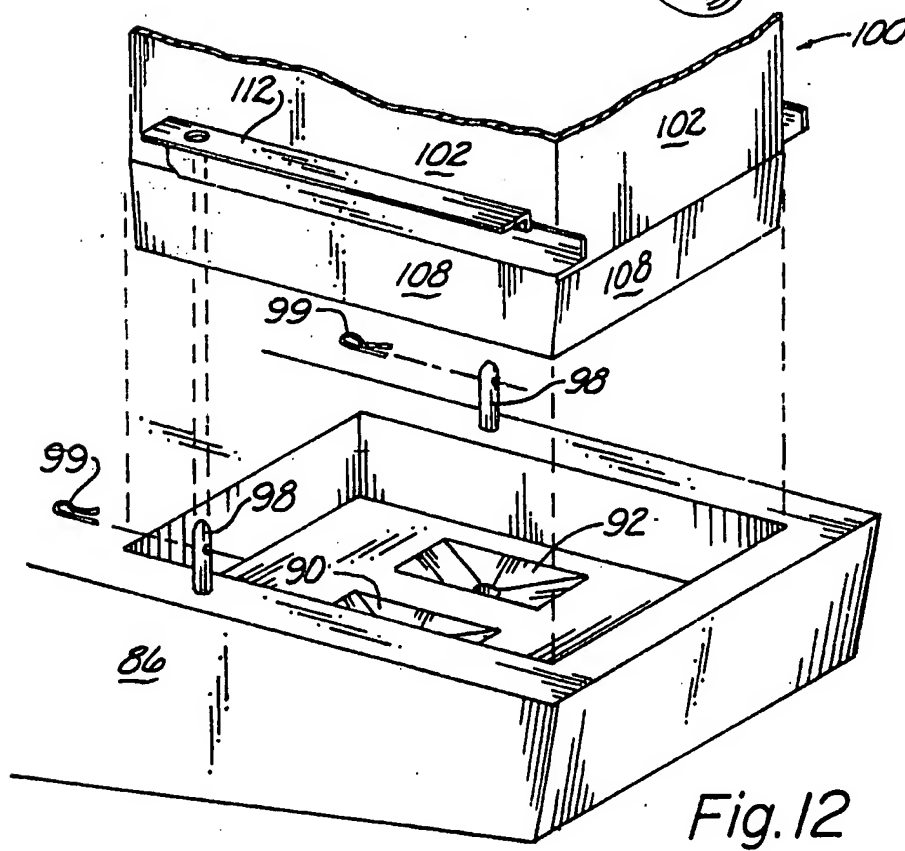
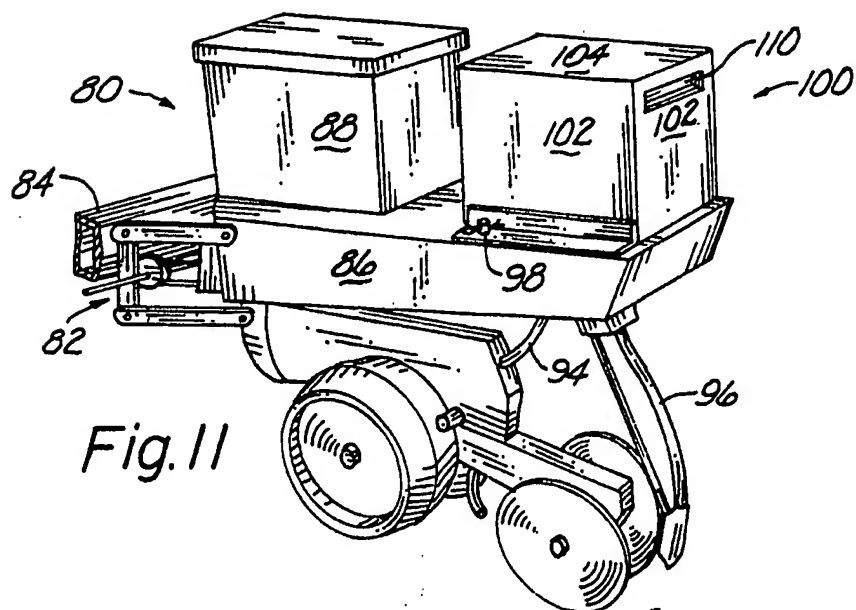
16. The metering device of any of Claims 9-15 wherein the material is granular.

17. The metering device of any of Claims 9-16 wherein the material is an agricultural material and the implement is an agricultural implement.

1 / 7









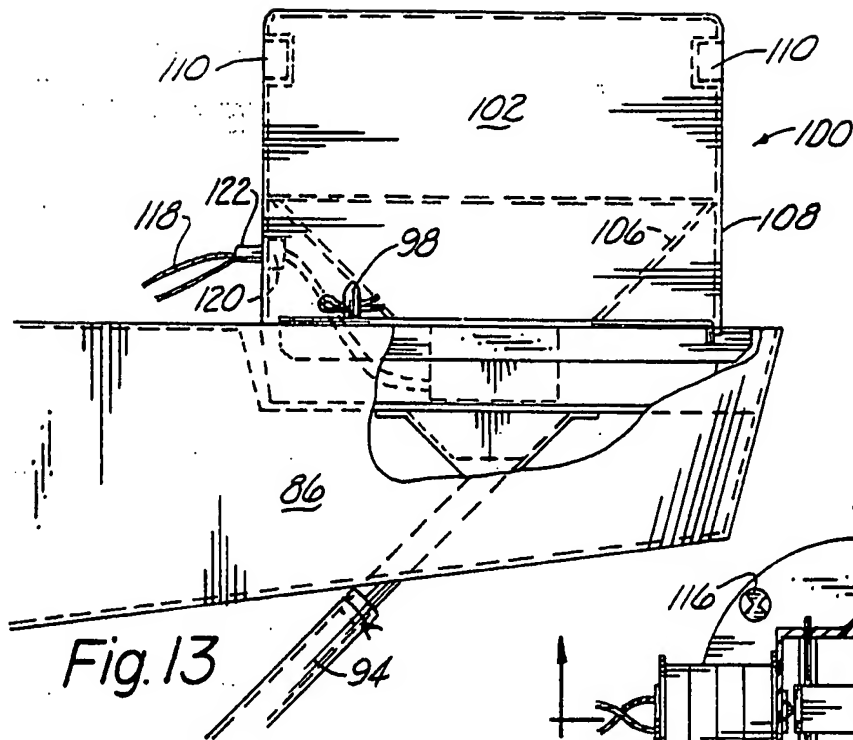


Fig. 13

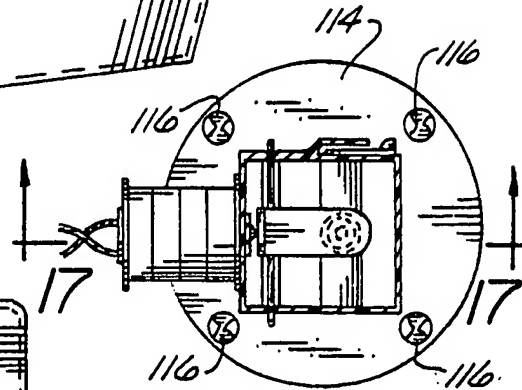


Fig. 16

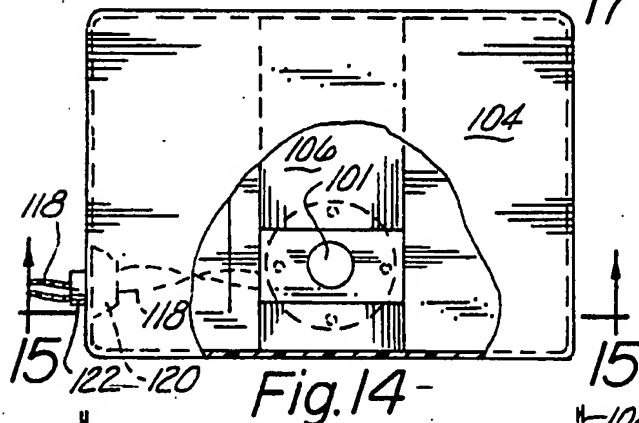


Fig. 14

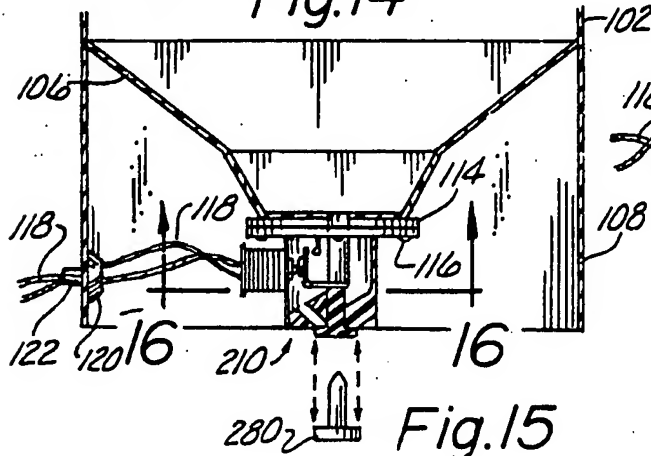


Fig. 15

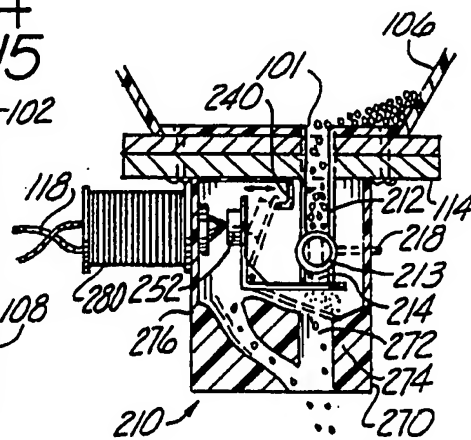


Fig. 17

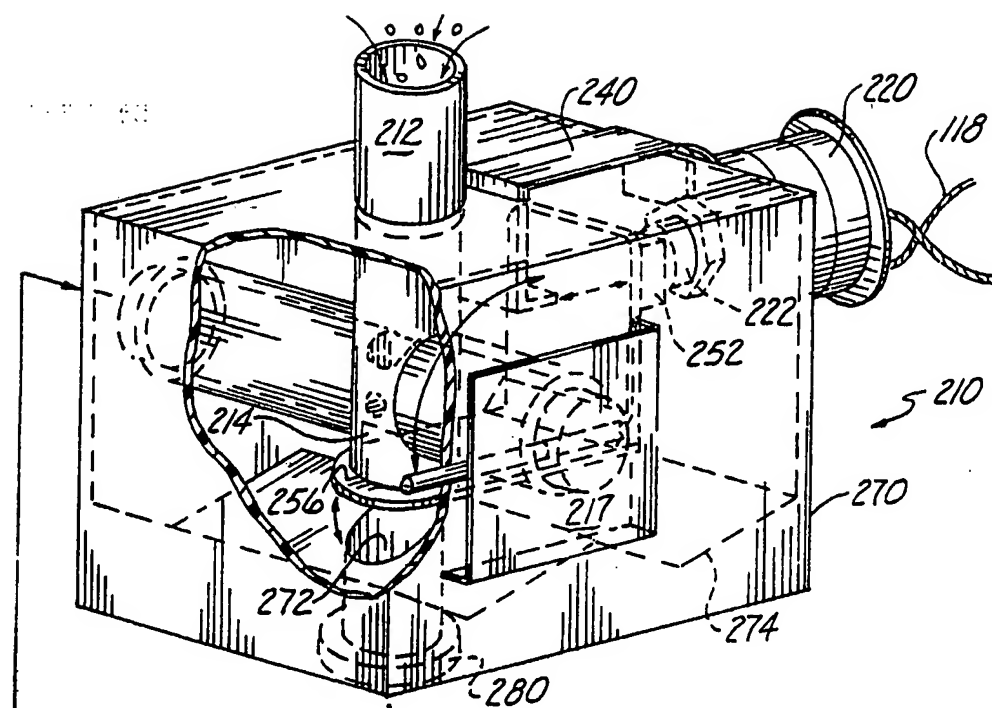


Fig. 18

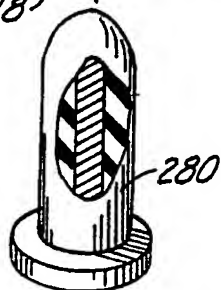
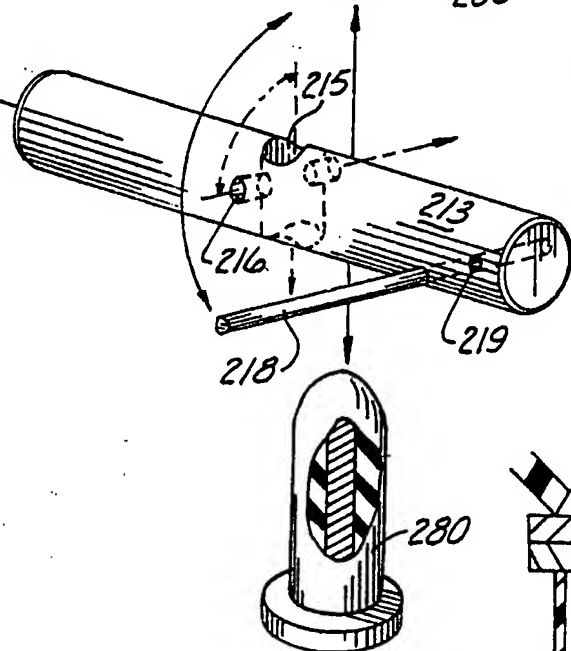
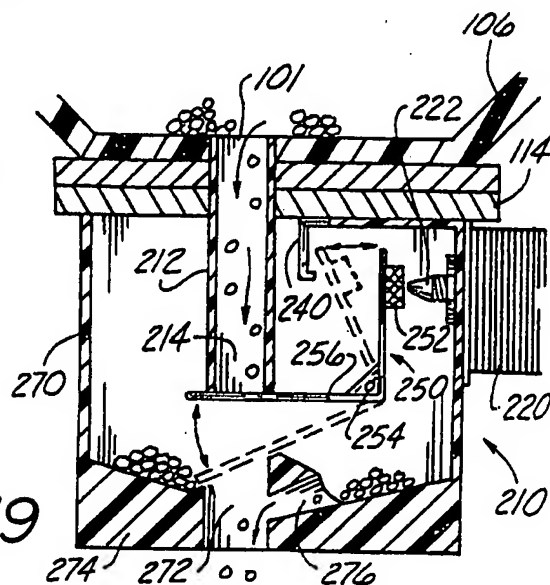
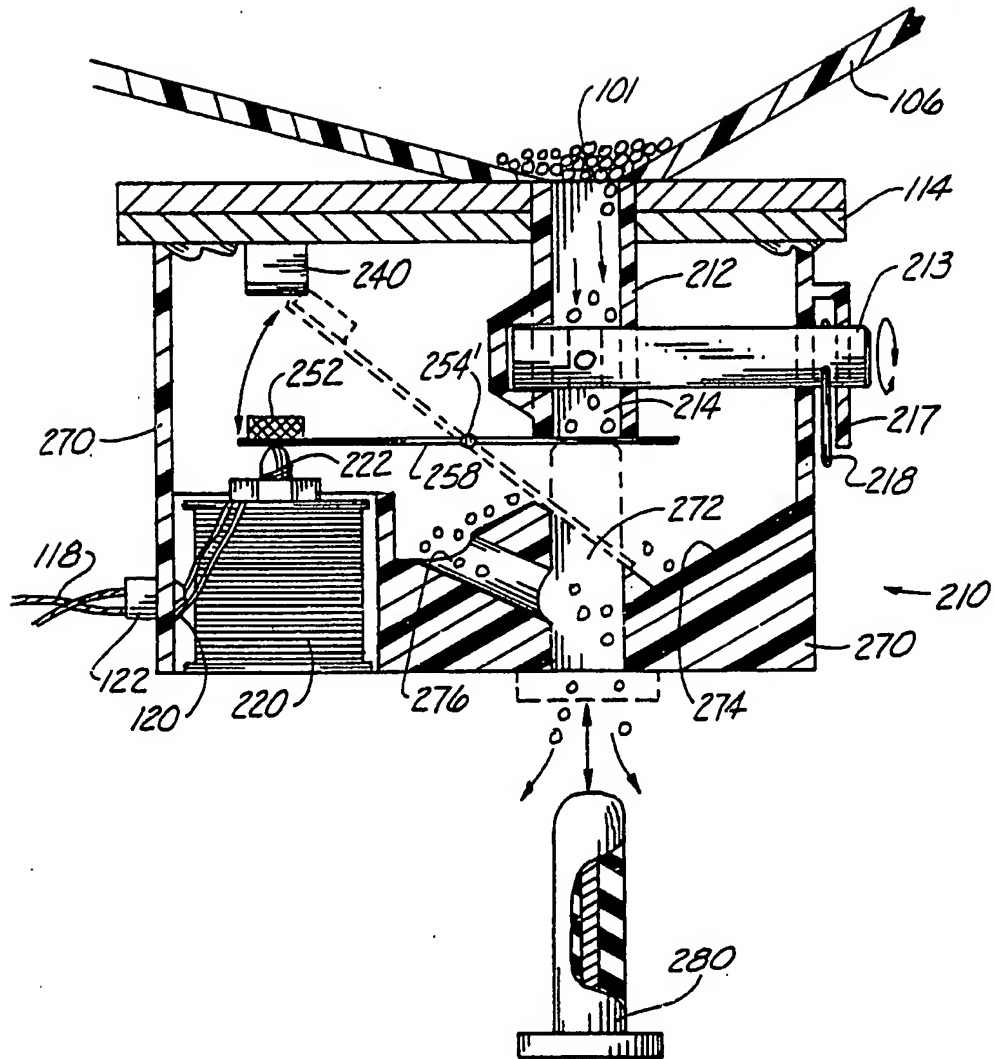


Fig. 19



*Fig. 20*

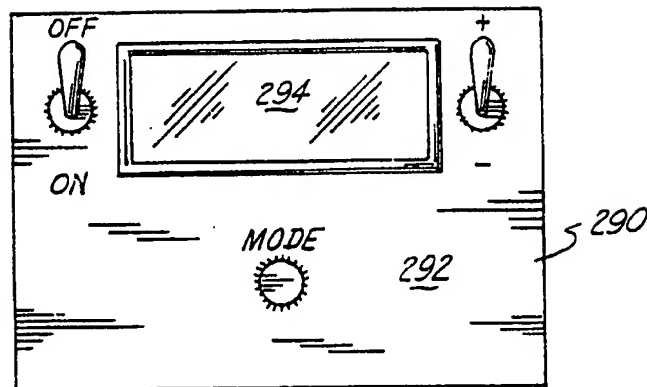


Fig. 21

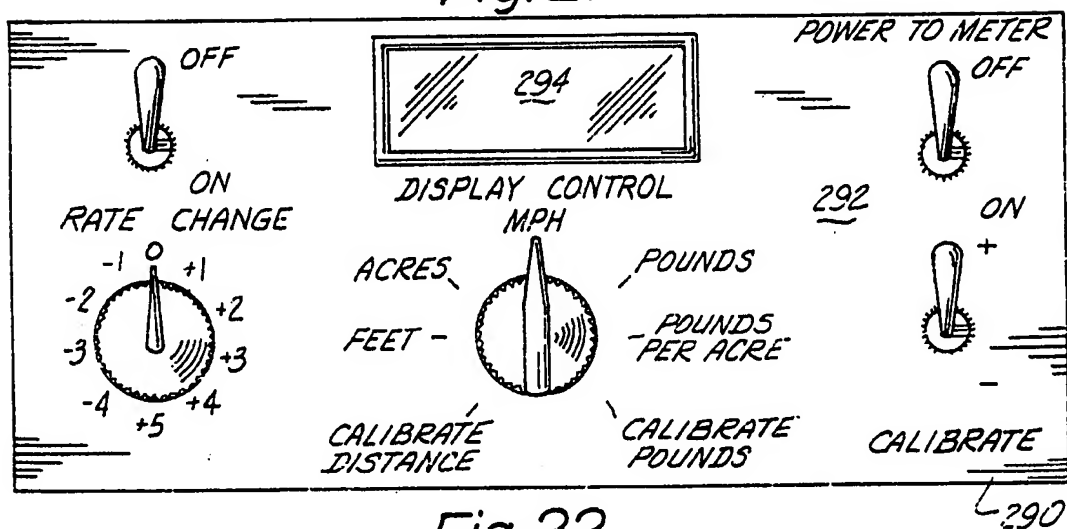


Fig. 22

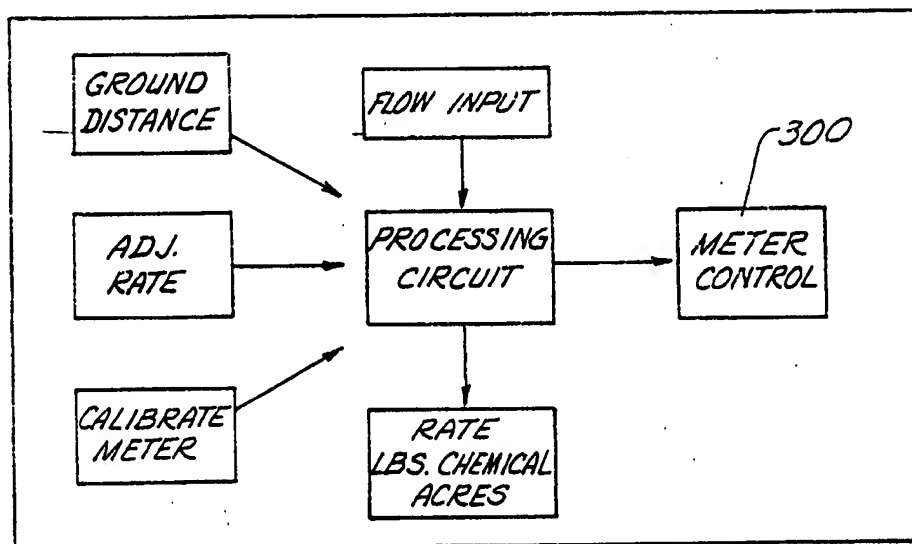


Fig. 23

## INTERNATIONAL SEARCH REPORT

Inter nal Application No  
PCT/US 93/09521

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 5 A01C7/10 A01C7/18

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC 5 A01C B65B F16K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	US,A,5 156 372 (CONRAD L.) 20 October 1992 cited in the application see the whole document ---	1,3,4,8
X	US,A,2 904 219 (RATMEYER W.) 15 September 1959 see column 1, line 52 - column 4, line 21; figures 1-7 ---	1-5,8
A	---	9-17
A	US,A,2 536 790 (ASHTON E.W.) 2 January 1951 see the whole document ---	1-5,8-17
A	US,A,2 442 794 (WILCOX J.R.) 8 June 1948 ---	
	-/--	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

## \* Special categories of cited documents :

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*&\* document member of the same patent family

Date of the actual completion of the international search

26 January 1994

Date of mailing of the international search report

21. 03. 94

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl,  
Fax (+ 31-70) 340-3016

Authorized officer

Elsworth, D

# INTERNATIONAL SEARCH REPORT

Inter. Patent Application No  
PCT/US 93/09521

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p> <b>DATABASE WPI</b>  <b>Week 8228,</b>  <b>Derwent Publications Ltd., London, GB;</b>  <b>AN 82-J4157E</b>  <b>&amp; SU,A,865 167 (DUNDUA G.A.) 26 September</b>  <b>1981</b>  <b>see abstract</b> </p> <p style="text-align: center;">-----</p>	1

# INTERNATIONAL SEARCH REPORT

Information on patent family members

Int. .ional Application No

PCT/US 93/09521

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-5156372	20-10-92	NONE	
US-A-2904219		NONE	
US-A-2536790		NONE	
US-A-2442794		NONE	